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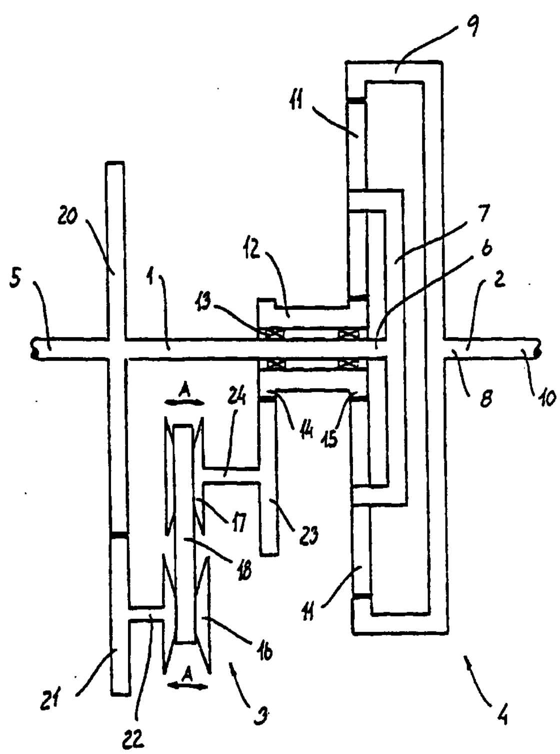
(57) Abstract

The invention relates to an infinitely adjustable gear which comprises an input shaft (1), an output shaft (2), a variator (3) in the form of an infinitely adjustable transmission mechanism, preferably a V-belt mechanism, and a planet gear (4). By driving a solar wheel (12) in the planet gear (4) via the variator, it is possible to provide a gear having a very large gearing range and which simultaneously enables direct transmission of power without any loss of transmission at all in the gear. The gear further comprises coupling and locking devices which increase the operational properties of the gear, in particular when direct power transmission is established. In this situation it is thus possible to effect locking of the solar wheel while simultaneously disengaging the variator.



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INFINITELY ADJUSTABLE GEAR

BACKGROUND OF THE INVENTION

The present invention relates to a gear comprising a variator which comprises at least a primary and a secondary wheel that are interconnected, and a planet gear which comprises a solar wheel, a planet wheel, a corona wheel and planet carriers, said planet wheel comprising an input shaft and an output shaft which are connected to the corona wheel.

Various embodiments of gears of the above-described type are known that have certain common features but which are, nevertheless, different with respect to the way in which the individual mechanical elements are combined.

DE 27 14 234 describes a gear with a planet gear and an infinitely adjustable transmission mechanism in the form of a disc gear. The input shaft of the gear also constitutes the planet gear shaft and is provided with a solidly mounted solar wheel while the output shaft is mounted on the planet gear carrier. The infinite variations in the gearing ratio are effected by driving an independent corona wheel independently of the remaining wheels in the planet gear.

Such gear is associated with several drawbacks. For instance, it is impossible to transmit forces of particular magnitude. Moreover, a transmission will always occur via the solar wheel and transmission will never be effected directly via the planet wheels to the corona wheel where all wheels in the planet gear are locked relative to each other whereby the input shaft is locked relative to the output shaft, nor will a direct transmission ever occur by coupling of the input shaft to the output shaft.

US 4,644,820 describes a gear which comprises a planet wheel in combination with a V-belt transmission. In addition to the

V-belt transmission, a toothed belt transmission is also provided. The various components of the gear are connected by means of couplings and free-wheel mechanisms which serve to regulate when the transmission is to be transmitted from one transmission mechanism to another.

It is one of the drawbacks of the gear described in said US disclosure that the transmission will always be effected via the V-belt and/or the toothed belt transmission in any driving situation. Thus, a considerable loss through the one and/or the other of these less effective transmission mechanisms will always occur.

It is the object of the present invention to provide an infinitely adjustable gear which covers a wide gearing range and which allows direct transmission independently of the infinitely adjustable transmission mechanism in the gear to reduce the transmission loss.

This object is achieved with a gear of the type described above which is characterised in that a rotation axis (A) for the input shaft serves as a rotation axis for the solar wheel through a rotatable bedding of the solar wheel about the rotation axis (A) of the input shaft, that a mutual mechanical connection has been established between the input shaft and the primary wheel for the variator, and that a mutual mechanical connection has been established between a drive wheel which is mounted on a rotation axis for the secondary wheel of the variator and a drive corona on the solar wheel.

Above and in the following the term "variator" serves to designate an infinitely adjustable transmission mechanism.

A preferred embodiment of the gear according to the invention is further characterized in that the input shaft is provided with a first drive wheel which is in communication with a second drive wheel, said second drive wheel being connected

to the primary wheel for the infinitely adjustable transmission mechanism, and that the secondary wheel of the infinitely adjustable transmission mechanism is connected to a third drive wheel which is in communication with the drive corona on the solar wheel.

According to an alternative embodiment of the gear according to the invention, the gear is characterized in that it is provided with a differential arranged about the rotation axis (A) of the input shaft, that the differential is intended for regulating the rotation of the solar wheel via the variator, and that the differential is arranged between the drive wheel mounted on a rotation shaft for the secondary wheel for the variator and the drive corona on the solar wheel.

According to a particular embodiment of the alternative embodiment of the invention, the gear is characterized in that the differential is provided with a dual coupling which may lock the wheels in the differential to each other in a first position in order to allow the differential to serve as a rigid element, and that the dual coupling locks the equalization wheel in the differential to a planet gear shaft in a second position whereby the differential serves as a differential gear.

According to a further alternative embodiment of the invention, the gear is characterized in comprising a connecting wheel which is in communication with the variator and provided with a first coupling between the connecting wheel and the solar wheel for transmitting the transmission from the variator via the connecting wheel to the solar wheel and the planet wheels, that the gear further comprises a secondary solar wheel and a secondary planet wheel, and that the connecting wheel is provided with a second coupling between the connecting wheel and the secondary solar wheel for transmitting the transmission from the variator via the connecting

wheel to the secondary solar gear, the secondary planet gear and the planet wheel.

Preferably, the variator is a V-belt mechanism with a primary and a secondary pulley wheel. Alternatively the variator may consist of other known and described infinitely adjustable transmission mechanisms.

A gear of this type presents important advantages. Given the fact that the variator is provided between the input shaft and the solar wheel, it is possible to obtain a very high gearing ratio, i.e. a low gearing, when a large momentum is required or when the output shaft for the gear is to rotate at a low speed of rotation. In this case, a major portion of the transmission will be effected via the variator which allows for the high gearing ratio. However, this is at the expense of a certain transmission loss, primarily in the variator.

Conversely, when a very low gearing ratio is desired, i.e. a high gearing, when the requirements to the momentum are less severe, or when the output shaft for the gear is to rotate at a high speed of rotation, the major portion of the transmission energy is transmitted directly through the planet gear and only a minor portion through the variator whereby the transmission loss is small.

However, the transmission loss which occurs in case of the high gearing ratios is not particularly important. This is due to the fact that the high gearing ratios are often used in connection with the starting of the machinery or means of transportation into which the gear is incorporated. The starting is effected over a very short period of time compared to the total operational life and thus the loss incurred in connection with the starting process constitutes a very limited portion compared to the total loss incurred during its operational life.

Therefore it is far more important that the transmission loss during the normal operational life span is maintained at as low a level as possible. This is fully realized with the present invention wherein the loss by direct transmission is reduced to near zero.

A gearing ratio of 1:1 of the input shaft to the output shaft for the gear, i.e. a direct gearing, may be obtained by locking the planet gear. Such locking may be effected anywhere in the planet gear. It may be between the planet wheels and the corona wheel, between the planet wheels and the planet carriers, between the planet wheels and the solar wheel, between the input shaft proper and the output shaft, or between the solar wheel and the input shaft. It is necessary to provide a disconnecting mechanism together with the locking of the planet gear to engage the transmission via the variator.

However, the gear functions in such a manner that the closer the gearing is to the low gearing ratios the smaller a portion of the transmission will be effected via the variator and the smaller the transmission loss.

Moreover, it will be possible to include an overgear in the planet gear. This may be done by providing the solar wheel with a brake. When the solar wheel is braked, the corona wheel and the output shaft will rotate at a higher speed of rotation than the planet carriers and the input shaft for given dimensions of the solar wheel and the planet wheels. Thus, the gearing ratio depends on the dimensions of the solar wheel and the planet wheels, respectively.

Moreover it will be possible to include a reversal. It may be provided by permitting the solar wheel to rotate with a higher speed of rotation than the speed of rotation which corresponds to neutral gearing. The gearing ratio in case of reversal depends on the dimensions of the solar wheel and the

planet wheels, respectively, and the relative difference in speeds of the solar wheel and the planet carriers.

Finally, neutral gearing is obtained by allowing the solar wheel to rotate at a speed which causes the speed of rotation of the corona wheel to be zero. The speed at which the solar wheel is to rotate depends on the mutual diameter ratio (and thus the tooth ratio) of the solar wheel and the planet wheels to the corona wheel, respectively. The neutral gearing is obtained at a speed of rotation of the solar wheel which is to be found between a speed of rotation which entails the maximum gearing ratio, i.e. the lowest possible gearing, and a speed of rotation which corresponds to a reversal. It will be possible to omit a conventional coupling mechanism between the output shaft of a drive motor and the input shaft of the gear box by making use of the neutral gearing of the gear.

Thus, the gear mechanism according to the present invention ranges from low gearing ratios with high gearing, including overgear and direct gearing with low momentum and high speed of rotation of the output shaft and with little transmission loss, through high gearing ratios with low gearing and increased momentum and lower speed of rotation of the output shaft and with a certain transmission loss, to neutral gearing and reversal.

The alternative and further alternative embodiments provide a very wide gearing range with high efficiency and distinguish themselves by allowing for very high gearings. The gearing for these embodimens are comprised within four ranges, a low range, a high range, an overdrive range and a reversal range, respectively. The infinitely adjustable gearing in each range is effected by modification of the gearing ratio in the variator while shifts between the individual ranges are effected by disengagement or engagement of the individual elements of the gear.

The gear according to the invention will be particularly suitable for passenger cars which, during far the major part of their operational lives, operate at a low gearing ratio, i.e. high gearing. The gear will be less suitable for lorries or other motor vehicles, such as tractors, which, during a major part of their operational lives, operate at a high gearing ratio, i.e. at low gearing.

DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the accompanying drawings, wherein

Fig. 1 is a principle view of a first embodiment of a gear according to the invention,

Fig. 2 is a principle view of an alternative embodiment of a gear according to the invention, and

Fig. 3 is a principle view of a preferred embodiment of a gear according to the invention,

Fig. 4 is a principle view of an alternative embodiment of a gear according to the invention, and

Fig. 5A is a principle view of a further alternative embodiment of a gear according to the invention.

Fig. 5B is a sectional view through the principle view of the further alternative embodiment of a gear according to the invention.

Figure 1 illustrates a first, basic embodiment of a gear according to the invention. The gear comprises an input shaft 1, an output shaft 2, a variator in the form of a V-belt mechanism 3, and a planet gear 4.

The input shaft has a first end 5 which is intended for being connected to a power supply unit (not shown). Another end 6 debouches into planet carriers 7 which are integral with the planet gear 4. The output shaft has a first end 8 which is connected to a corona wheel 9 which is integral with the

planet gear 4. The output shaft further has another end 10 which is intended for being connected to that portion of a device (not shown) which is to be operated by the power supply unit via the gear.

Furthermore, in addition to planet carriers 7 and corona wheels 9, the planet gear 4 comprises planet wheels 11 which are mounted on the planet carriers which are, as mentioned, mounted at the other end 6 of the input shaft 1. Additionally, the planet gear 4 comprises a solar wheel 12. The solar wheel 12 is arranged about the input shaft by means of bearings 13 and thus it may rotate about the input shaft.

The variator 3 comprises a primary pulley wheel 16, a secondary pulley wheel 17 and a V-belt 18. The primary pulley wheel is secured to the input shaft. Between the secondary pulley wheel 17 and the solar wheel 12 a drive mechanism is provided in the form of a toothed belt 19 or the like mechanism which transmits the transmission from the secondary pulley wheel 17 to the solar wheel 12.

Figure 2 illustrates an alternative embodiment of the gear according to the invention. The structure of the planet gear in this embodiment is identical to that of the planet gear according to the embodiment illustrated in fig. 1. In this embodiment, the variator 3 also comprises a primary pulley wheel 16, a secondary pulley wheel 17 and a V-belt 18. The variator 3 is regulated in a known manner by adjustment of the axial distance between the pulley wheels' 16,17 abutment faces for the pulley. The solar wheel 12 is provided with two toothed coronae, a first toothed corona 14 and a second toothed corona 15 which engage with the planet wheels 11.

A first toothed wheel 20 is mounted on the input shaft 1 and connected to a second toothed wheel 21 which is mounted on a rotation shaft 22 of the primary pulley wheel 16. A third toothed wheel 23 is mounted on a rotation shaft 24 for the

secondary pulley wheel 17. This third toothed corona 23 engages with the first toothed corona 14 of the solar wheel 12.

In the embodiment shown the variator is a V-belt mechanism. The variation in the gearing ratio in this mechanism is illustrated by the two-way arrows A. However, other variators may conceivably be used.

During operation of the gear, a transmission is effected partly via the variator 3 and partly via the planet gear 4. The gearing ratio of the planet gear 4 depends i.a. on the size of the solar wheel 12, the planet wheel 11 and the corona wheel 9. Additionally the gearing ratio depends on the speed of rotation of the input shaft 1 and the speed of rotation of the solar wheel 12. The speed of rotation of the input shaft 1 depends on the speed of rotation of the outgoing drive shaft (not shown) of the power supply unit while the speed of rotation of the solar wheel 12 depends partly on the speed of rotation of the input shaft 1 and partly on the actual gearing rate within the variator 3.

In the following, the functioning of the gear will be described in further detail with reference to an embodiment wherein the diameter of the solar wheel 13 is half of the diameter of the planet wheels 11 and thus one fifth of the diameter of the corona wheel 9, which yields a ratio of solar wheel, planet wheel to corona wheel of 1:2:5.

In case of a low gearing ratio in the variator 3 correspon-ding to a large effective diameter for the primary pulley wheel 16 and a lower effective diameter of the secondary pulley wheel 17, the solar wheel will rotate quickly in this situation. If the solar wheel 12 rotates at a rate which is 6 times higher than the speed of rotation of the input shaft 1, the planet carriers 7, the corona wheel 9 will thus come to a halt corresponding to neutral gearing. Thus, in prin-

ciple it will be possible to avoid coupling in the transition between the drive shaft (not shown) of the power supply unit and the outgoing shaft 2 of the gear.

In case the gearing ratio within the variator 3 is reduced to such an extent that the solar wheel 12 rotates slower, the corona wheel 9 will begin to rotate at a speed of rotation which depends on the speed of rotation of the input shaft 1 and the solar wheel 12. This situation corresponds to a slow starting of the machinery into which the gear is incorporated. A major portion of the transmission is effected via the variator 3 since the solar wheel 12 rotates at a relatively high rate in the starting situation.

By further reducing the gearing ratio in the variator 3 the solar wheel 12 will gradually rotate at a lower rate. When the speed of rotation of the solar wheel is equal to the speed of rotation of the input shaft 1, a gearing ratio of input shaft to output shaft of 1:1 is obtained, i.e. a direct gearing.

Part of the force of the transmission will, in all gearing ratios, be engaged to the variator since the solar wheel 12 is being driven by the planet wheels 11 which rotate in the planet carriers 7 which would otherwise not move relative to the solar wheel. However, in direct gearing this may be avoided by incorporation of coupling means which disconnect the variator as will be described below with reference to fig. 2.

If the speed of rotation of the solar wheel 12 is further reduced to cause the speed of rotation of the solar wheel to be less than the speed of rotation of the input shaft 1 by increasing the gearing rate in the V-belt mechanism, a situation occurs where a gearing ratio of input shaft to output shaft is 1:(>1), i.e. an overgear situation.

Conversely, if the speed of rotation of the solar wheel is increased to such an extent that the speed of rotation exceeds six times the speed of rotation of the input shaft, e.g. to seven times, the gearing ratio of input shaft to output shafts will be 1:-0.2, i.e. a reversal, with the ratio of solar wheel, planet wheel to corona wheel given above of 1:2:5. The gearing ratio is reduced numerically as the speed of rotation of the solar wheel 12 is further increased beyond the speed of rotation of six times the speed of rotation of the input shaft 1. In case of a speed of rotation of the solar wheel 12 of six times the speed of rotation of the input shaft, neutral gearing is obtained.

It will appear from the above that the gear provided in accordance with the invention is a gear which is infinitely adjustable by regulation of the solar wheel by means of a variator.

Figure 3 illustrates a preferred embodiment of the gear according to the invention. The structural principle of this preferred embodiment is identical with that of the embodiment shown in fig. 1 and in principle it functions in the same manner. However, coupling, locking and braking means are arranged at certain points in the gear to increase the ease of operation and the efficiency of the gear.

A first coupling 25 is mounted between the input shaft 1 and the first toothed wheel 20. A second coupling 26 is mounted between the third toothed wheel 23 and the rotation shaft 24 for the secondary pulley wheel 17. A lock 27 is arranged between the solar wheel 12 and the input shaft 1 which forms the rotation shaft of the solar wheel, and a brake 28 is arranged on the solar wheel proper.

In the starting situation, the couplings 25,26 will be engaged since the variator is very important in this situation. When the gear reaches a gearing ratio of input shaft to

output shaft of 1:1 during operation, i.e. direct gearing, the solar wheel 12 rotates as described above at the same speed of rotation as the input shaft 1.

In this situation it will be possible to lock the solar wheel 12 relative to the input shaft 1 since they will rotate at the same rate anyway. This may be done by activating the lock 27 between the solar wheel 12 and the input shaft 1. At the same time it will be possible to disconnect the variator 3 since it does not serve a purpose when the solar wheel is locked relative to the input shaft. This is done by disengaging the couplings 25,26. In this way direct transmission is obtained through a fixed, direct gearing.

Since in this situation the individual toothed wheels 9,11,15 in the planet gear 4 are locked relative to each other, no transmission loss occurs in the planet gear. Since the variator 3 is disengaged no loss occurs in this part of the gear either. The transmission loss in the gear at a gearing ratio of 1:1 is thus reduced to zero. Of course transmission loss in other places of the unit will occur, e.g. from bearings.

In the situation when the solar wheel rotates at a lower speed of rotation than the input shaft, an overgear will be established as described above. If the solar wheel is braked completely by means of the brake 28 and is thus at a halt without performing any rotation, the gearing ratio of input shaft to output shaft will be 1:1.2 with the previously given ratio of solar wheel, planet wheel to corona wheel of 1:2:5. In this situation it will be necesary to disconnect the variator 3 thereby, however, only reducing the transmission loss.

The presence of coupling, locking and braking devices and the use thereof as described above, greatly increases the ease of

operation of the gear according to the invention and reduces the transmission loss.

Figure 4 illustrates af further embodiment of the gear according to the invention. The gear illustrated in this figure consists of several elements and have an increased gearing range with high efficiency.

A first coupling 25 is mounted between the input shaft 1 and the first toothed wheel 20. A secondary coupling 29 is mounted between the input shaft 1 and a planet gear shaft 30, and a third coupling 31 is mounted between the planet gear shaft 30 and a reference plate 32 in the gear housing (not shown) in which the gear is mounted.

In the embodiment shown the solar wheel 12 is combined and integral with a differential 33 that transmits the transmission from the third toothed wheel 23 to a first shaft drive 38 via the equalization wheel 34 to the solar wheel 12. In the embodiment shown the solar wheel 12 constitutes a second shaft drive for the differential 33. Between the equalization wheels 34 in the differential 33 and the planet gear shaft 30 a carrier 35 for the equalization wheels 34 is provided with a shaft 39 about which the equalization wheels 34 rotate. A coupling 36 is mounted between the carrier 35 and the first shaft drive 38 in such a manner that the differential may be blocked relative to the planet gear shaft 30. A coupling 37 is mounted between the carrier 35 and the planet gear shaft 30 in such a manner that the rotation of the equalization wheels 34 about the planet gear shaft 39 may be blocked, but not the rotation of the equalization wheels 34 about their own shaft 39.

The further elements comprised by this embodiment compared to the embodiment illustrated in fig. 3, viz. the couplings 29,31 between the input shaft 1 and the planet gear shaft 30 and between the planet gear shaft 30 and gear housing 32,

differential 33 and carrier 35 with the couplings 36,37, respectively, mean that the gearing ratios in the gear may be varied over a wider range with high performance compared to the previously illustrated embodiments. Moreover the efficiency and the functionality at low gearing and reversal is increased and the overdrive range is also widened.

In the starting situation which occurs in the low gearing range the coupling 29 between the input shaft 1 and the planet gear shaft 30 is disengaged while the coupling 31 between the planet gear shaft 30 and the gear housing 32 is engaged. The coupling 25 between the input shaft 1 and the first toothed wheel 20 is engaged at starting. Thus, transmission occurs exclusively via the variator 3.

In the differential 33 the coupling 37 is engaged whereas the coupling 36 is disengaged. As mentioned, the coupling 31 is engaged thus bringing the planet gear shaft 30 to a halt. This means that the direction of rotation of the input shaft 1 is shifted when the transmission is conveyed through the differential 33 but the transmission is once again shifted when the transmission is conveyed through the planet gear 4 to cause the output shaft 2 to rotate in the same direction of rotation as the input shaft 1 but at a lower speed of rotation depending on the ratio of the diameter of the solar wheel 12 to that of the corona wheel 9.

By increasing the gearing to the high gearing range, the coupling 31 will be disengaged whereas the coupling 29 will be engaged. The coupling 25 between the input shaft 1 and the first toothed wheel 20 is still engaged. Thus, the transmission is effected both via the variator 3 and through the planet gear shaft 30 which now rotates with the input shaft 1.

In the differential 33 the coupling 37 will be disengaged whereas the coupling 36 will be engaged. In this manner the

solar wheel 12 is in direct communication with the variator 3 since, in this situation, the differential 33 only constitutes a rigid element without specific technical properties of transmission. In this situation the gear functions like the embodiment shown in fig. 2 and reference is made to the description of this figure.

By further increasing the gearing to the overdrive range, the coupling 37 in the differential 33 will be engaged whereas the coupling 36 will be disengaged. This is most conveniently done when the speed of rotation of the solar wheel 12 via the variator 3 is reduced to the same speed as the speed of rotation of the planet carrier 7.

Continuous reduction of the speed of rotation of the solar wheel 12 by means of the variator 3 and via the first shaft shaft drive 38 and the equalization wheels 34 will increase the gearing. At a point in time in connection with the increase of the gearing, the solar wheel 12 will begin to rotate in reverse direction relative to the input shaft 1 by the differential 33 reversing the direction of rotation relative to the input shaft 1. This occurs as a consequence of a modification of the mutual relative speed of rotation between the differential 33 and the planet gear shaft 30. The direction of rotation will still be the same as that of the input shaft 1.

During reversal of the gear in the embodiment shown, the coupling 31 between the planet gear shaft 30 and the gear housing 32 is engaged whereas the coupling 29 between the input shaft 1 and the planet gear shaft 30 is disengaged. Like the starting situation in case of low gearings, the transmission is thus exclusively effected via the variator 3. In the differential 33 the coupling 37 is disengaged whereas the coupling 36 is engaged. Thereby the variator 3 transmits the transmission directly to the solar wheel 12 since, in the relevant situation, the differential 33 constitutes a rigid

element without specific technical properties of transmission. The planet carriers 7 are locked since the coupling 31 between the planet gear shaft 30 and the reference plane 32 in the gear housing is engaged. Thus, the solar wheel 12 transmits the transmission via the planet wheels 11 to the corona wheel 9 and the output shaft 2 with a direction of rotation which is oriented opposite the direction of rotation of the input shaft 1 and has a speed of rotation which depends on the ratio of the diameter of the solar wheel to that of the corona wheel.

Figure 5A illustrates and embodiment of the gear according to the invention which is only slightly different from the embodiment shown in fig. 4. The difference consists in the absence of a differential on the gear which is instead provided with a connecting wheel 40, a secondary solar wheel 41 and secondary planet wheels 42. The functioning of this gear, however, corresponds largely to the functioning of the gear with differential illustrated in fig. 4.

Figure 5B illustrates how the secondary planet wheels 42 which are arranged on the planet carrier 7 are in mesh with the planet wheels 11.

In the starting situation which occurs in the low gearing range, the coupling 36 between the connecting wheel 40 and the secondary solar wheel 41 is engaged whereas the coupling 37 between the connecting wheel 40 and the solar wheel 12 is disengaged. The coupling 29 between the input shaft 1 and the planet gear shaft 30 is disengaged whereas the coupling 31 between the planet gear shaft 30 and the gear housing 32 is engaged. Thus, the transmission takes place exclusively via the variator as was the case with the embodiment illustrated in fig. 4.

The connecting wheel 40 transmits the transmission to the secondary solar wheel 41 which further transmits the trans-

mission to the secondary planet wheels 42 which operate the planet wheels 11. The transmission is further transmitted to the corona wheel 9 and the output shaft 2.

By increasing the gearing to the high gearing range, the coupling 29 will be engaged, the coupling 31 will be disengaged, the coupling 36 will be disengaged and the coupling 37 will be engaged like the embodiment illustrated in fig. 4. In this situation, the gear functions in the same manner as the embodiment of fig. 2 and reference is made to the description made to this figure. Since the coupling 36 is disengaged, the secondary planet wheels 42 will not make technical contributions of transmission in this situation.

By further increasing the gearing to the overdrive range, the coupling 36 between the connecting wheel 40 and the secondary solar wheel 41 will be engaged whereas the coupling 37 between the connecting wheel 40 and the solar wheel 12 will be disengaged.

A reduction of the secondary planet wheels' 42 speed of rotation about their own axes by means of the variator 3 will increase the gearing. The rotation of the secondary planet wheels 42 about the planet gear shaft will range from a speed of rotation of 0 and to numerically higher speeds of rotation in the overdrive range, but have a direction of rotation about its own axis which is oriented opposite the direction of rotation about their own axes as exhibited by the secondary planet wheels in the low gearing ranges. The direction of rotation of the corona wheel 9 and the output shaft 2 will still be identical with the one of the input shaft 1.

In case of reversal of the gear of the embodiment shown, the coupling 31 between the planet gear shaft 30 and the gear housing 32 is engaged whereas the coupling 29 between the input shaft 1 and the planet gear shaft 30 is disengaged. Like in the starting situation, the transmission is thus

exclusively effected via the variator 3 like in the embodiment illustrated in fig. 4.

The coupling 36 between the connecting wheel 40 and the secondary solar wheel 41 is disengaged while the coupling 37 between the connecting wheel 40 and the solar wheel 12 is engaged. The variator 3 thus transmits the transmission directly to the connecting wheel 40 and thus to the solar wheel 12 since, in this situation, the secondary solar wheel 41 and the secondary planet wheels 42 do not make technical contributions of transmission. The planet carriers 7 are locked as the coupling 31 between the planet gear shaft 30 and the gear housing 32 is engaged. The solar wheel 12 thus transmits the transmission via the planet wheels 11 to the corona wheel 9 and the output shaft 2 with a direction of rotation which is opposite the direction of rotation of the input shaft 1 and at a speed of rotation which depends on the ratio of the diameter of the solar wheel 12 to that of the corona wheel 9.

The embodiments shown in the figures are to be considered principle sketches of preferred embodiments according to the present invention. Thus, the individual elements of the gear may be provided in other ways, i.e. with other dimensions.

The ratio of solar wheel, planet wheel to corona wheel of 1:2:5 is thus to be regarded as exemplary. Likewise, the variator constitutes one embodiment of an infinitely adjustable transmission mechanism while other mechanisms may be used. The connection between the individual toothed wheels and toothed coronae outside the planet gear may moreover be established in the form of pulley belts or pulley chains for one or more of the toothed-wheel connections. Drive mechanisms other than toothed wheels, belts and chains may also be used. In this context, the term "drive wheel" which has been used previously will serve to designate such alternative drive mechanisms.

<u>Claims</u>

1. A gear comprising a variator (3) that comprises at least a primary (16) and a secondary wheel (17) which are connected to each other and a planet gear (4) that comprises solar wheel (12), planet wheel (11), corona wheel (9) and planet carriers (7), said gear comprising an input shaft (1) and an output shaft (2) connected to the corona wheel (9), characterized in that an axis of rotation (A) for the input shaft (30) constitutes the axis of rotation of the solar wheel (12) through a rotatable bedding (13) of the solar wheel about the axis of rotation (A) for the input shaft, that a mutually mechanical communication is established between the input shaft and the primary wheel (16) for the variator, and that a mutually mechanical communication has been established between a drive wheel (23) which is mounted on a shaft of rotation (24) for the secondary wheel (17) for the variator and a drive corona (14) on the solar wheel (12).

2. A gear according to claim 1, characterized in that the input shaft (1) is provided with a first drive wheel (20) which is in communication with a second drive wheel (21), said second drive wheel being connected to the primary wheel (16) for the variator, and that the secondary wheel (17) for the infinitely adjustable transmission mechanism is connected to a third drive wheel (23) which is in communication with the drive corona (14) on the solar wheel (12).

3. A gear according to any one of the preceding claims, characterized in that a coupling device (25) is provided somewhere between the input shaft (1) and the primary wheel (16), preferably between the input shaft (1) and the first drive wheel (20).

4. A gear according to any one of the preceding claims, c h a r a c t e r i z e d in that a coupling device (26) is provided somewhere between the secondary wheel (17) and the solar wheel (12), preferably between the secondary wheel (17) and the third drive wheel (23), more preferably between the third drive wheel and the solar wheel (12).

5. A gear according to any one of the preceding claims, c h a r a c t e r i z e d in that the gear is provided with a locking device provided somewhere between the input shaft (1) and the output shaft (2) to ensure direct transmitting of transmission between the input shaft and the output shaft, preferably by the planet gear (14) being provided with a locking device to prevent mutual shifting between the wheels (9,11,12) of the planet gear.

6. A gear according to any one of preceding claims, c h a r a c t e r i z e d in that the solar wheel (12) is provided with a locking device (27) arranged between the input shaft (1) and the solar wheel (12).

7. A gear according to any one of the preceding claims, c h a r a c t e r i z e d in that the solar wheel (12) is provided with a brake (28).

8. A gear according to claim 1 or 2, c h a r a c t e r i - z e d in that the gear is provided with a differential (33) arranged about the rotation axis (A) of the input shaft (1), that the differential (33) is intended for regulating the rotation of the solar wheel (12) via the variator (3), and that the differential (33) is arranged between the drive wheel (23) which is mounted on a shaft of rotation (24) for the secondary wheel for the variator (3) and the drive corona (14) on the solar wheel (12).

9. A gear according to claim 8, c h a r a c t e r i z e d in that the differential (33) is provided with a dual

coupling (35) which, in a first position, may lock wheels in the differential (33) to each other so that the differential serves as a rigid element, and that the dual coupling (35) in a second position locks the equalization wheels (34) in the differential (33) to a planet gear shaft (30) to allow the differential to serve as a differential gear.

10. A gear according to claim 9, c h a r a c t e r i z e d in that the dual coupling (35) is provided between equalization wheels (34) for the differential (33) and the planet gear shaft (30), that a coupling (36) is mounted between the dual coupling (35) and a first shaft drive (38) for the differential, and that a coupling (37) is mounted between the dual coupling (35) and the planet gear shaft (30).

11. A gear according to claim 1 or 2, c h a r a c t e r i - z e d in that the planet gear (4) is provided with secondary planet wheels (42), that a connecting wheel (40) and a secondary solar wheel (41) is provided between the solar wheel (12) and the secondary planet wheels (42), that the connecting wheel (40) is in communication with the variator (3), that a coupling (36) is mounted between the connecting wheel (40) and the secondary solar wheel (41), and that a coupling (37) is mounted between the solar wheel (12) and the connecting wheel (40).

12. A gear according to any one of the preceding claims, c h a r a c t e r i z e d in that the variator (3) is a V-belt mechanism which comprises at least a primary and a secondary pulley wheel.

13. A gear according to any one of claims 2-12, c h a - r a c t e r i z e d in that the communication between the first (20) and the second drive wheel (21), that the communication between the third drive wheel (23) and the drive corona (14) on the solar wheel (12) are provided by drive means in the form of a belt or a chain.

14. A gear according to any one of claims 2-13, c h a - r a c t e r i z e d in that the first, the second and the third drive wheels are toothed wheels, that the drive corona on the solar wheel is a toothed corona, that the first toothed wheel is in mesh with the second toothed wheel, and that the third toothed wheel is in mesh with the toothed corona on the solar wheel.

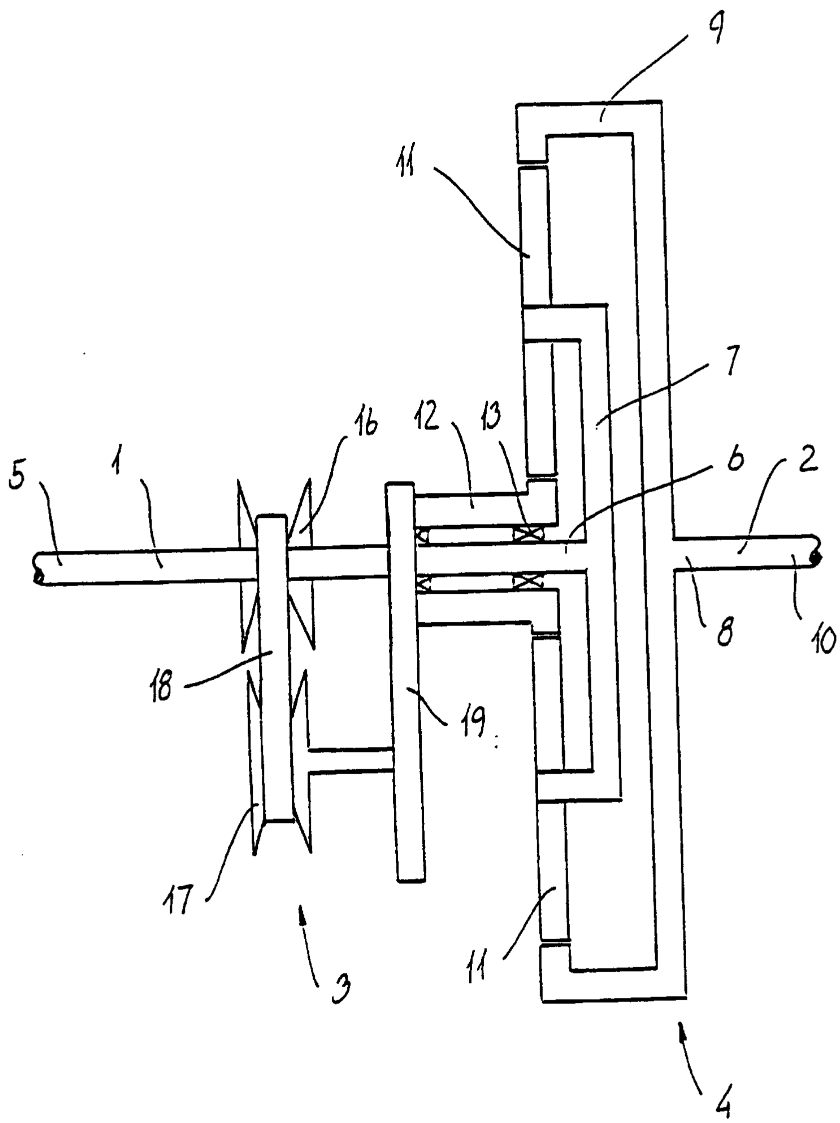

FIG. 1

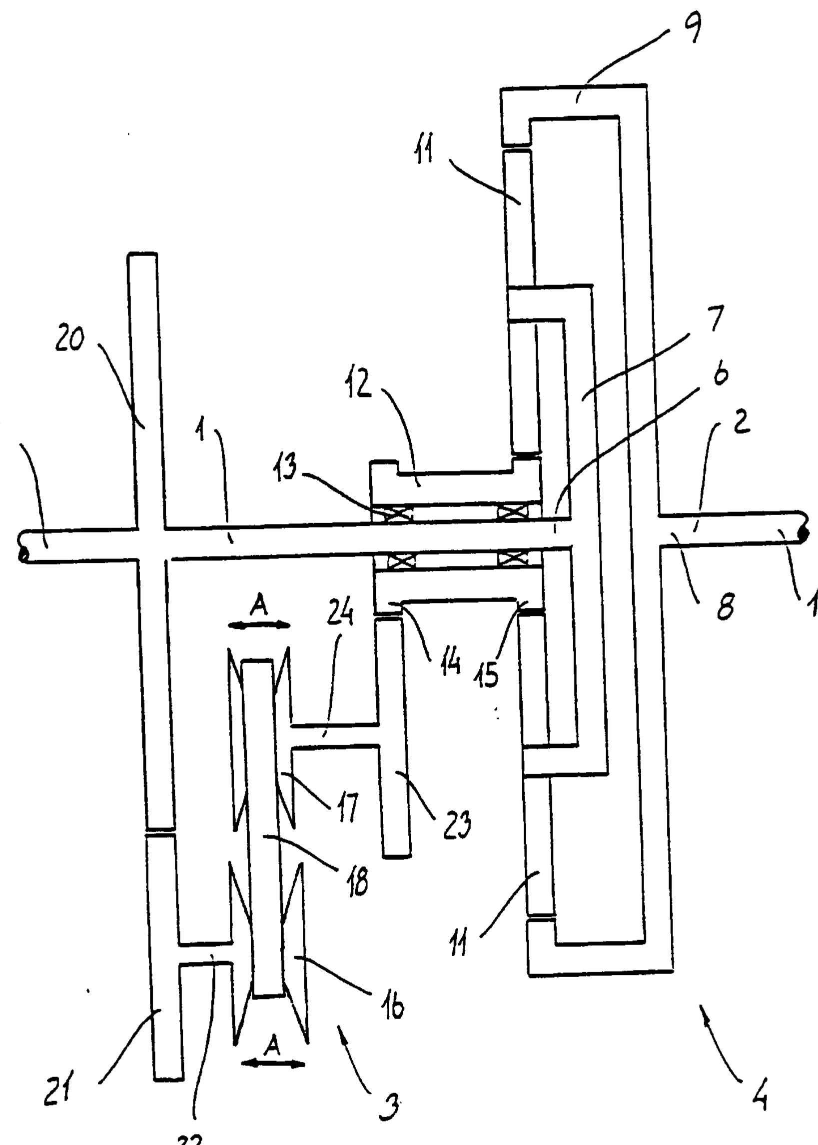

FIG. 2

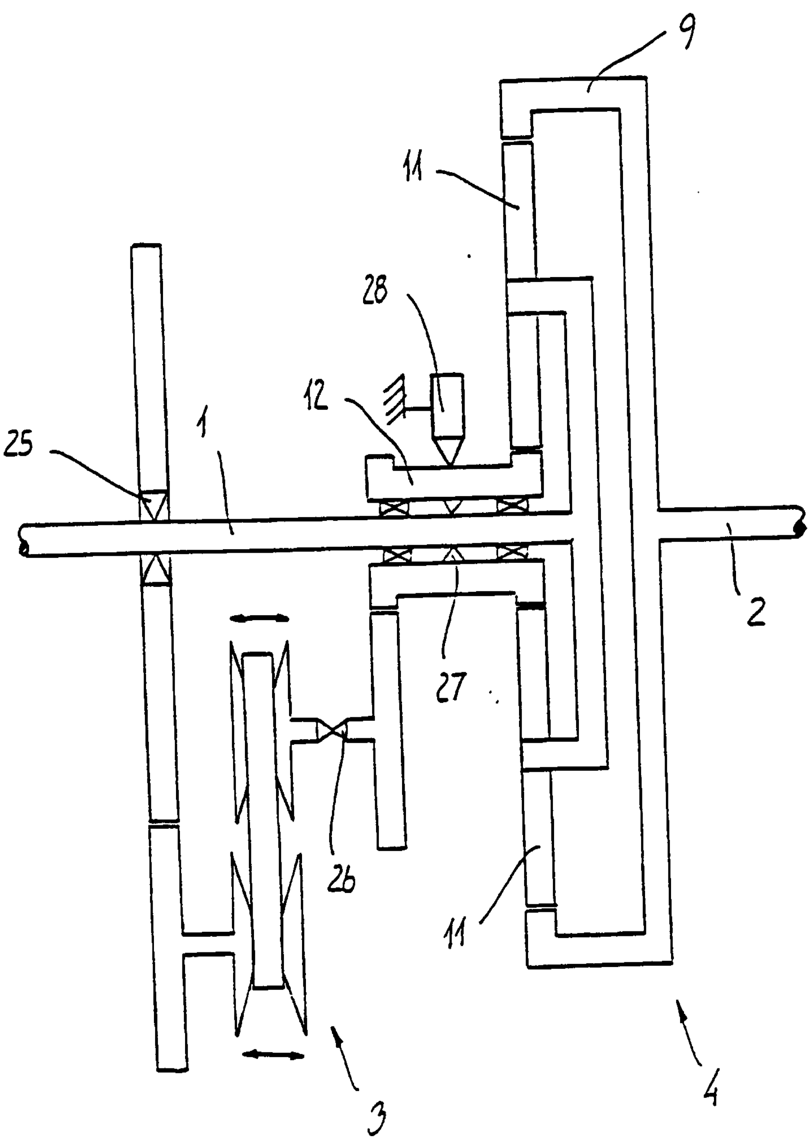

FIG. 3

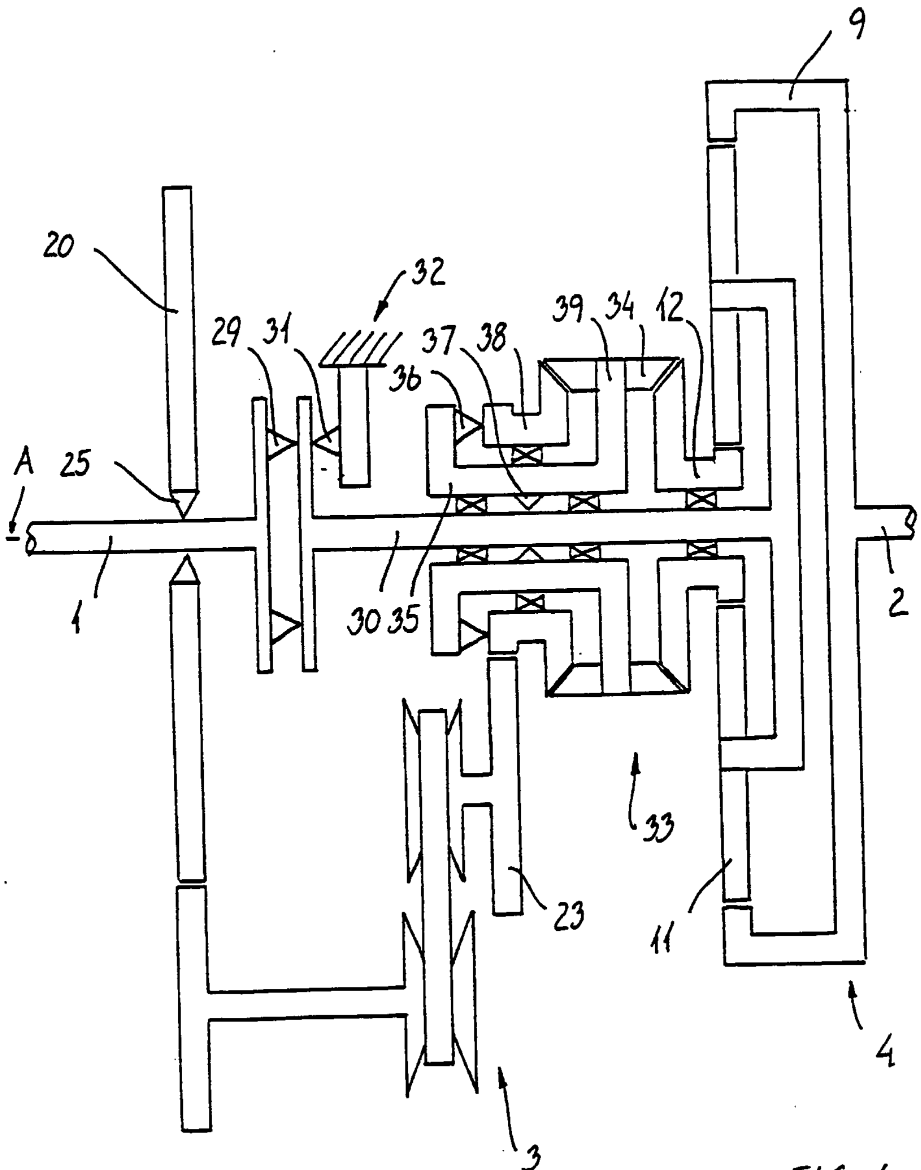

FIG. 4

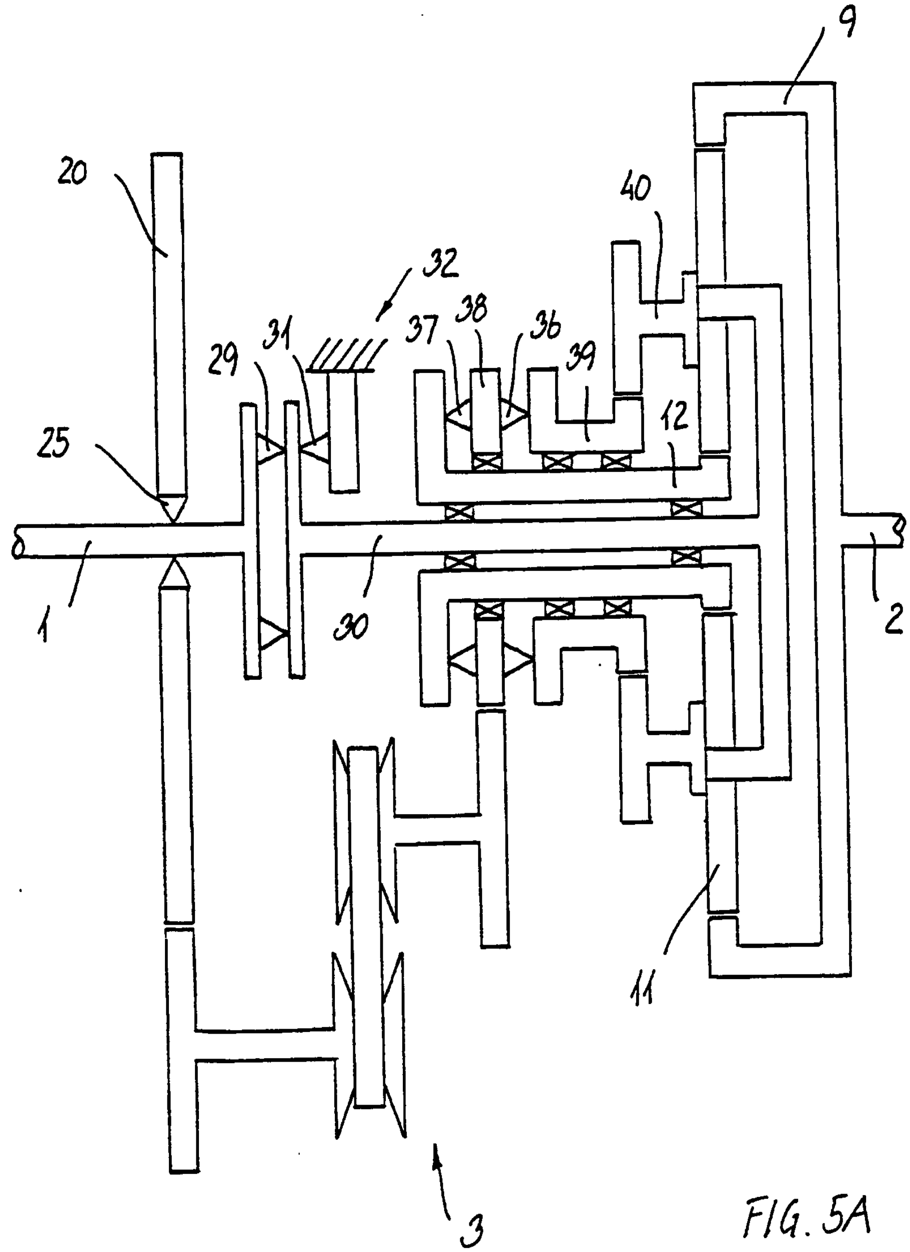

FIG. 5A

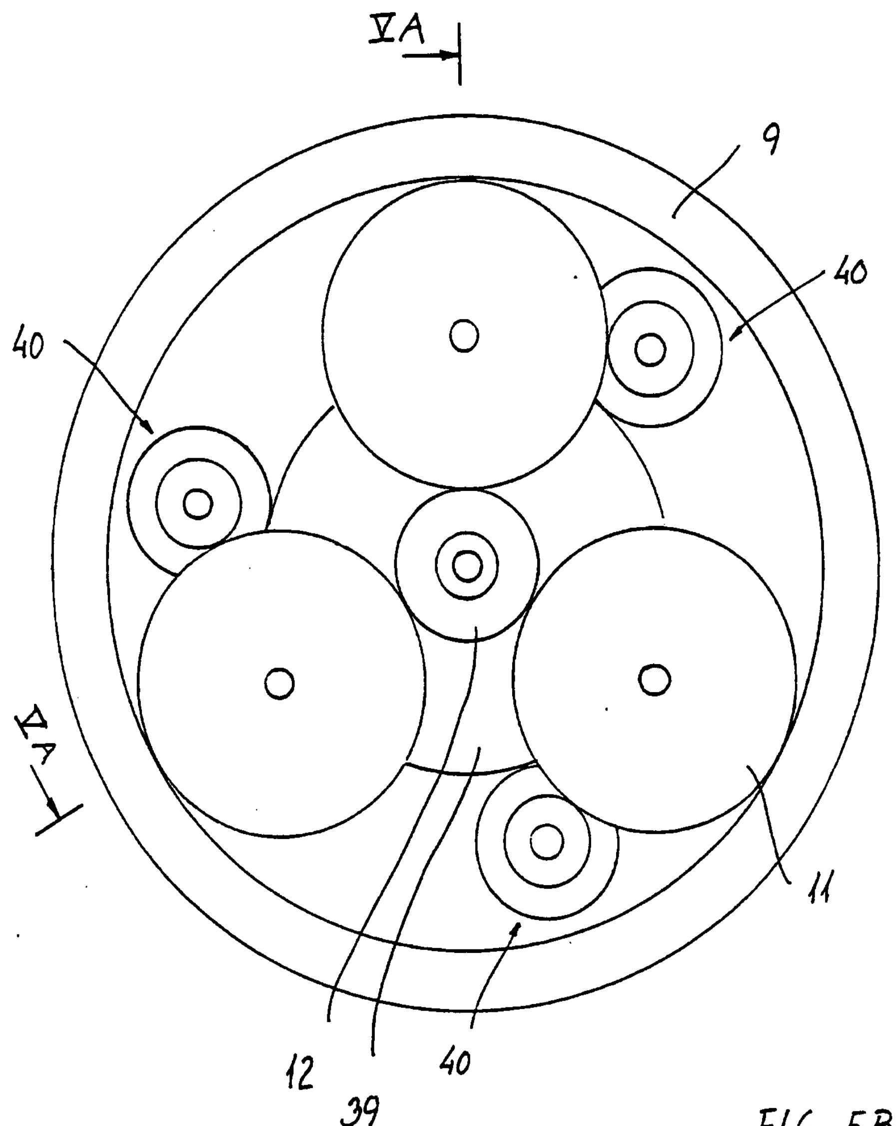

FIG. 5B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 95/00237

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F16H 3/72, F16H 37/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9203671 A1 (TOROTRAK (DEVELOPMENT) LIMITED), 5 March 1992 (05.03.92), page 3, line 35 - page 5, line 6, figure 3	1,2,3,5,11, 14
Y		4,6-14
	--	
Y	GB 1128694 A (DEERE & COMPANY), 2 October 1968 (02.10.68), page 2, line 3 - page 3, line 42, figure 4	1-7,12-15
	--	
Y	DE 1625030 A (DEERE & COMPANY), 5 February 1970 (05.02.70), page 8, line 8 - page 9, line 12, figures 4,6	1-7,12-14
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 Sept 1995	28 -09- 1995
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Per-Olof Warnbo Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 95/00237

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0173482 A1 (BORG-WARNER CORPORATION), 5 March 1986 (05.03.86), page 5, line 14 - page 7, line 21, figure 1 --	1-7,11-14
Y	US 4913003 A (TERVOLA), 3 April 1990 (03.04.90), column 12, line 43 - column 15, line 15, figures 8, 9 -- --------	1,8-14

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/DK 95/00237

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		AU-A- 8412391	17/03/92
		CA-A- 2088911	18/02/92
		EP-A- 0542861	26/05/93
		GB-A,B- 2263142	14/07/93
		JP-T- 5509383	22/12/93
		US-A- 5401221	28/03/95
GB-A- 1128694	02/10/68	NONE	
DE-A- 1625030	05/02/70	NONE	
EP-A1- 0173482	05/03/86	AU-A- 4570585	06/03/86
		JP-A- 61062654	31/03/86
US-A- 4913003	03/04/90	AU-A- 5105090	24/08/90
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		WO-A- 9008909	09/08/90